

WHAT IS CLAIMED IS:

1. An electrical interconnect structure on a substrate, comprising:
 - 5 a first porous dielectric layer with surface region from which porogen has been removed; and
an etch stop layer disposed upon said first porous dielectric layer so that said etch stop layer extends to partially fill pores in the surface region
10 of said first porous dielectric layer from which said porogen has been removed.
- 15 2. The electrical interconnect structure of claim 1, further comprising a second porous dielectric layer disposed upon said etch stop layer.
3. The electrical interconnect structure of claim 2, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of an organic dielectric material.
- 20 4. The electrical interconnect structure of claim 2, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of a material wherein the porosity is formed as a result of decomposition of a sacrificial porogen.
- 25 5. The electrical interconnect structure of claim 2, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of a material selected from the group consisting of porous SiLKTM and GX-3pTM.

6. The electrical interconnect structure of claim 2, wherein the first porous dielectric layer has a thickness in the range of substantially 600 - 5000 Angstroms.
- 5 7. The electrical interconnect structure of claim 2, wherein the second porous dielectric layer has a thickness in the range of substantially 600-5000 Angstroms.
- 10 8. The electrical interconnect structure of claim 2, wherein said etch stop layer is comprised of a spin-on material with etch selectivity to the porous dielectric layers.
- 15 9. The electrical interconnect structure of claim 2, wherein said etch stop layer is comprised of a material selected from the group consisting of HOSP™, HOSP BEST™, Ensemble™ Etch Stop, Ensemble™ Hard Mask, organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.
- 20 10. The electrical interconnect structure of claim 2, wherein the etch stop layer has a thickness of substantially 200 - 600 Angstroms.
- 25 11. The electrical interconnect structure of claim 2, further comprising a plurality of patterned metal conductors formed within a multi layer stack of porous dielectric layers on the substrate, said stack including at least the first porous dielectric layer, the etch stop layer, and the second porous dielectric layer.
- 30 12. The electrical interconnect structure of claim 10, wherein at least one of the patterned metal conductors is an electrical via.

13. The electrical interconnect structure of claim 12, wherein at least one of the patterned metal conductors is a line connected to said via.

14. The electrical interconnect structure of claim 2, wherein the first
5 porous dielectric layer has a metal via formed therein.

15. The electrical interconnect structure of claim 2, wherein the second porous dielectric layer has a metal line formed therein.

10 16. The electrical interconnect structure of claim 2, further comprising a hardmask layer disposed upon said second porous dielectric layer so that said hardmask layer extends to partially fill pores in a surface region of said second porous dielectric layer from which said porogen has been removed.

15 17. The electrical interconnect structure of claim 16, wherein said hard mask layer is comprised of a material with etch selectivity to the porous dielectric.

20 18. The electrical interconnect structure of claim 16, wherein said hard mask layer is comprised of a material selected from the group consisting of HOSPTM, HOSP BESTTM, EnsembleTM Etch Stop, EnsembleTM Hard Mask, ,organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.

25 19. The electrical interconnect structure of claim 16, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of a material selected from the group consisting of porous SiLKTM and GX-3pTM.

30

20. The electrical interconnect structure of claim 16, wherein said first and second porous dielectrics layers are comprised of organic dielectrics, and said etch stop layer is one of an inorganic low-k dielectric material and an inorganic/organic hybrid material.
- 5
21. The electrical interconnect structure of claim 2, wherein said inorganic low-k dielectric etch stop layer is porous.
22. The electrical interconnect structure of claim 1, wherein the first porous dielectric layer is comprised of an organic dielectric material.
- 10
23. The electrical interconnect structure of claim 1, wherein the first porous dielectric layer is comprised of a material wherein the porosity is formed as a result of decomposition of a sacrificial porogen.
- 15
24. The electrical interconnect structure of claim 1, wherein the first porous dielectric layer is comprised of a material selected from the group consisting of porous SiLK™, GX-3p™.
- 20
25. The electrical interconnect structure of claim 1, wherein the first porous dielectric layer has a thickness in the range of substantially 600 – 5000 Angstroms.
26. The electrical interconnect structure of claim 1, wherein said etch stop layer is comprised of a spin-on material with etch selectivity to the porous dielectric of the dielectric layer.
- 25
27. The electrical interconnect structure of claim 1, wherein said etch stop layer is comprised of a material selected from the group consisting of HOSP™, HOSP BEST™, Ensemble™ Etch Stop, Ensemble™ Hard Mask,
- 30

,organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.

28. The electrical interconnect structure of claim 1, wherein the etch
5 stop layer has a thickness of substantially 200 - 600 Angstroms.

29. The interconnect structure of Claim 1, wherein said substrate is a semiconductor wafers having an adhesion promoter layer formed thereon.

10 30. A method of forming an electrical interconnect structure on a substrate, comprising:

providing a first porous dielectric layer with surface region from which porogen has been removed; and

15

forming an etch stop layer upon said first porous dielectric layer so that said etch stop layer extends to partially fill pores in the surface region of said first porous dielectric layer from which said porogen has been removed.

20

31. The method of claim 30, further comprising removing the porogen from the first surface region.

32. The method of claim 31, wherein the porogen is removed by
25 heating.

33. The method of claim 30, wherein the porogen is removed by baking in a hot plate bake chamber.

30 34. The method of claim 30, further comprising forming a second porous dielectric layer upon said etch stop layer.

35. The method of claim 34, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of an organic dielectric material.
- 5
36. The method of claim 34, further comprising forming porosity in at least one of the first porous dielectric layer and the second porous dielectric layer by decomposition of a sacrificial porogen initially in said layers.
- 10
37. The method of claim 34, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of a material selected from the group consisting of porous SiLKTM and GX-3pTM.
- 15
38. The method of claim 34, wherein the first porous dielectric layer has a thickness in the range of substantially 600 - 5000 Angstroms.
39. The method of claim 34, wherein the second porous dielectric layer
- 20 has a thickness in the range of substantially 600 - 5000 Angstroms.
40. The method of claim 34, wherein said etch stop layer is comprised of a material with etch selectivity to the porous dielectric layers.
- 25
41. The method of claim 34, wherein said etch stop layer is selected from the group consisting of HOSPTM, HOSP BESTTM, EnsembleTM Etch Stop, EnsembleTM Hard Mask, organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.
- 30
42. The method of claim 34, wherein the etch stop layer has a thickness of substantially 200 - 600 Angstroms.

43. The method of claim 34, further comprising forming a metal via in the first porous dielectric layer.
- 5 44. The method of claim 34, further comprising forming a metal line in the second porous dielectric layer.
45. The method of claim 34, further comprising forming a plurality of patterned metal conductors within a multi layer stack of porous dielectric layers on the substrate, said stack including at least the first porous dielectric layer, said etch stop layer, and the second porous dielectric layer.
- 10
46. The method of claim 45, further comprising:
- 15 adding additional dielectric layers; and
- completing the structure by adding conductors.
- 20 47. The method of claim 46, further comprising curing the dielectric layers to render the dielectric layer porous.
48. The method of claim 47, wherein said first porous dielectric, said etch stop, and said second porous dielectric layers in the stack are cured in a single step.
- 25
49. The method of Claim 48, wherein said curing is a furnace curing step conducted at a temperature of from about 300°C to about 450°C for about 15 minutes to about 3 hours.

50. The method of claim 47, wherein remaining porogen from the first and second porous dielectric layers is removed during said curing step.

51. The method of claim 47, wherein the remaining porogen degrades to low molecular weight compounds and diffuses out of the layer through free volume of the first and second porous dielectric layers and the buried etch stop layer during the curing step.

52. The method of claim 47, wherein the dielectric layers in the stack are cured after sequential application in a single tool.

53. The method of claim 52, wherein the tool is a spin coating tool containing high temperature hot plate baking chambers.

54. The method of claim 45, further comprising: forming at least one of the patterned metal conductors as an electrical via.

55. The method of claim 54, further comprising forming at least one of the patterned metal conductors as a line connected to said via.

56. The method of claim 34, further comprising forming a hardmask layer upon said second porous dielectric layer so that said hardmask layer extends to partially fill pores in surface regions of said second porous dielectric layer from which said porogen has been removed.

57. The method of claim 34, wherein said hardmask layer is a chemical mechanical polishing polish stop layer.

58. The method of claim 56, further comprising forming porosity at least one of the first porous dielectric layer and the second porous dielectric layer by decomposition of a sacrificial porogen

59. The method of claim 56, wherein at least one of the first porous dielectric layer and the second porous dielectric is formed of a material selected from the group consisting of porous SiLKTM and GX-3pTM.

5

60. The method of claim 56, wherein said hardmask layer is comprised of a spin-on material with etch selectivity to the porous dielectric layers.

61. The method of claim 56, wherein said hardmask layer is comprised of a material selected from the group consisting of HOSPTM, HOSP
10 BESTTM, EnsembleTM Etch Stop, EnsembleTM Hard Mask, ,organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.

15 62. The method of claim 56, wherein at least one of the first porous dielectric layer and the second porous dielectric layer is comprised of an organic dielectric material.

63. The method of claim 56, wherein the first porous dielectric layer, the
20 etch stop layer, the second porous dielectric layer and the hard mask layers are cured in a single step.

64. The method of claim 63, wherein said curing is a furnace curing step conducted at a temperature of from about 300°C to about 450°C for
25 about 15 minutes to about 3 hours.

65. The method of claim 63, wherein remaining porogen degrades to low molecular weight compounds and diffuses out of the structure through free volume of the first and second porous dielectric layers, the buried etch
30 stop layer and the hard mask layer during the curing step.

66. The method of claim 56, wherein the hard mask layer has a thickness of substantially 300 to substantially 1000 Angstroms.

67. The method of claim 34, further comprising forming a polish stop layer upon said second porous dielectric layer so that said polish stop layer extends to partially fill pores in surface regions of said second porous dielectric layer from which said porogen has been removed.

68. The method of claim 30, wherein the first porous dielectric layer is comprised of an organic dielectric material.

69. The method claim 30, further comprising forming porosity in the first porous dielectric layer by decomposition the porogen.

70. The method claim 30, wherein the first porous dielectric layer is comprised of a material selected from the group consisting of SiLK™ and GX-3p™.

71. The method of claim 30, wherein the first porous dielectric layer has a thickness in the range of substantially 600 - 5000 Angstroms.

72. The method of claim 30, wherein said etch stop layer is comprised of a spin-on material with etch selectivity to the porous dielectric layers.

73. The method of claim 30, wherein said etch stop layer is comprised of a material selected from the group consisting of HOSP™, HOSP BEST™, Ensemble™ Etch Stop, Ensemble™ Hard Mask, ,organo silsesquioxanes, hydrido silsesquioxanes, hydrido-organo silsesquioxanes, and siloxanes.

YOR920020153US2

74. The method of claim 30, wherein the etch stop layer has a thickness of substantially 200 to substantially 600 Angstroms.